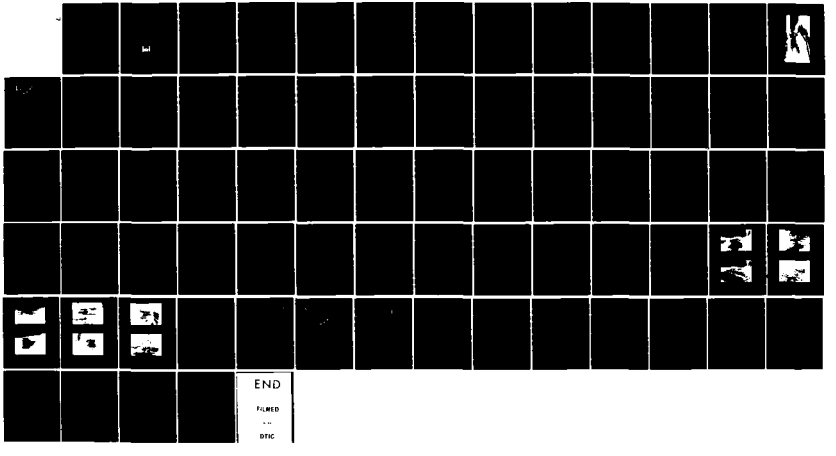
AD-A143 490 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/1
LOWER HART POND DAM (.. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV FEB 81

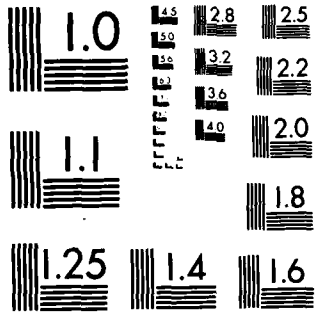
UNCLASSIFIED F/G 13/13 NL



END

FILMED

DTIC



CONNECTICUT RIVER BASIN
BERLIN, CONNECTICUT

LOWER HART POND DAM
CT 00247

AD-A143 490

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

FEBRUARY, 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CT 00247	2. GOVT ACCESSION NO. AD-A143 490	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Lower Hart Pond Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE February 1981 13. NUMBER OF PAGES 45
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Conn. River Basin
Berlin, Conn.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Lower Hart Pond Dam is an earth embankment that is approx. 1,420 feet long and 17.8 feet high. The embankment has 2.5:1 side slopes on the upstream and downstream faces with riprap protection on the upstream face. The assessment of the dam is based on a visual inspection, past operational performance and hydraulic/hydrologic computations. The dam is judged to be in FAIR condition with severe areas that require attention. The dam is classified as SMALL and has a HIGH hazard potential in accordance with guidelines established by the Corps of Engineers.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

MAR 10 1981

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Lower Hart Pond Dam (CT-00247) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, New Britain Water Department, 1000 Shuttle Meadow Avenue, New Britain, Connecticut 06052.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

LOWER HART POND DAM

CT 00247

CONNECTICUT RIVER BASIN

BERLIN, CONNECTICUT

Accession For	
NTIS GRA&I	X
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification Number:	CT 00247
Name:	Lower Hart Pond Dam
City:	Berlin
County and State:	Hartford County, Connecticut
Stream:	Mattabasset River
Date of Inspection:	October 21, 1980

BRIEF ASSESSMENT

The Lower Hart Pond Dam is an earth embankment that is approximately 1,420 feet long and 17.8 feet high. The embankment has 2.5:1 side slopes on the upstream and downstream faces with riprap protection on the upstream face. The spillway is located through the midsection of the dam and consists of a 30-foot long concrete weir. There are two 12-inch low-level discharge pipes that pass through the base of the dam. The gates for operating the discharge pipes are located in manholes on the downstream slope. There is also a 12-inch discharge pipe passing through the base of the spillway. These discharge pipes are used to drain the pond. The gates, however, have never been operated. Lower Hart Pond is used for water supply by the City of New Britain, Connecticut. The drainage area is 2.0 square miles and the reservoir has 825 acre-feet of storage capacity.

The assessment of the dam is based on a visual inspection, past operational performance and hydraulic/hydrologic computations. The dam is judged to be in FAIR condition with several areas that require attention. These areas include seepage through the dam in the vicinity of the low-level discharge pipes and wet spots along the toe of the dam, vegetation on the embankments as well as along the toe of the dam and the inoperable status of the low-level discharge pipe.

The dam is classified as SMALL and has a HIGH hazard potential in accordance with guidelines established by the Corps of Engineers. The test flood for this dam ranges from 1/2 the Probable Maximum Flood (PMF) to the PMF. The test flood for this dam is 1/2 the PMF and is calculated to be 1,020 cfs. The test flood outflow will not overtop the dam and will leave 0.4 feet of freeboard.

It is recommended that the owner engage the services of a qualified registered engineer experienced in the design of dams to investigate the seepage through the dam, investigate the depression at the outlet of the discharge pipe, supervise the removal of trees from the embankment, and study the possibility of putting the control gate on the upstream side of the embankment. It is also recommended that the owner remove brush from the upstream face, repair the discharge gate, check the erosion on the embankment, establish a formal warning system and initiate a maintenance program and an annual technical inspection.

The Owner should implement the recommendations and remedial measures described above and in greater detail in Section 7 within one year after receipt of this Phase I Inspection Report.

Joseph F. Merluzzo
Connecticut P.E. #7639
Project Manager

Gary J. Giroux
Connecticut P.E. #11477
Project Engineer

This Phase I Inspection Report on Lower Hart Pond Dam **has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.**

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Inspections. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Inspection is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Inspection; however, the investigation is intended to identify any need for such studies.

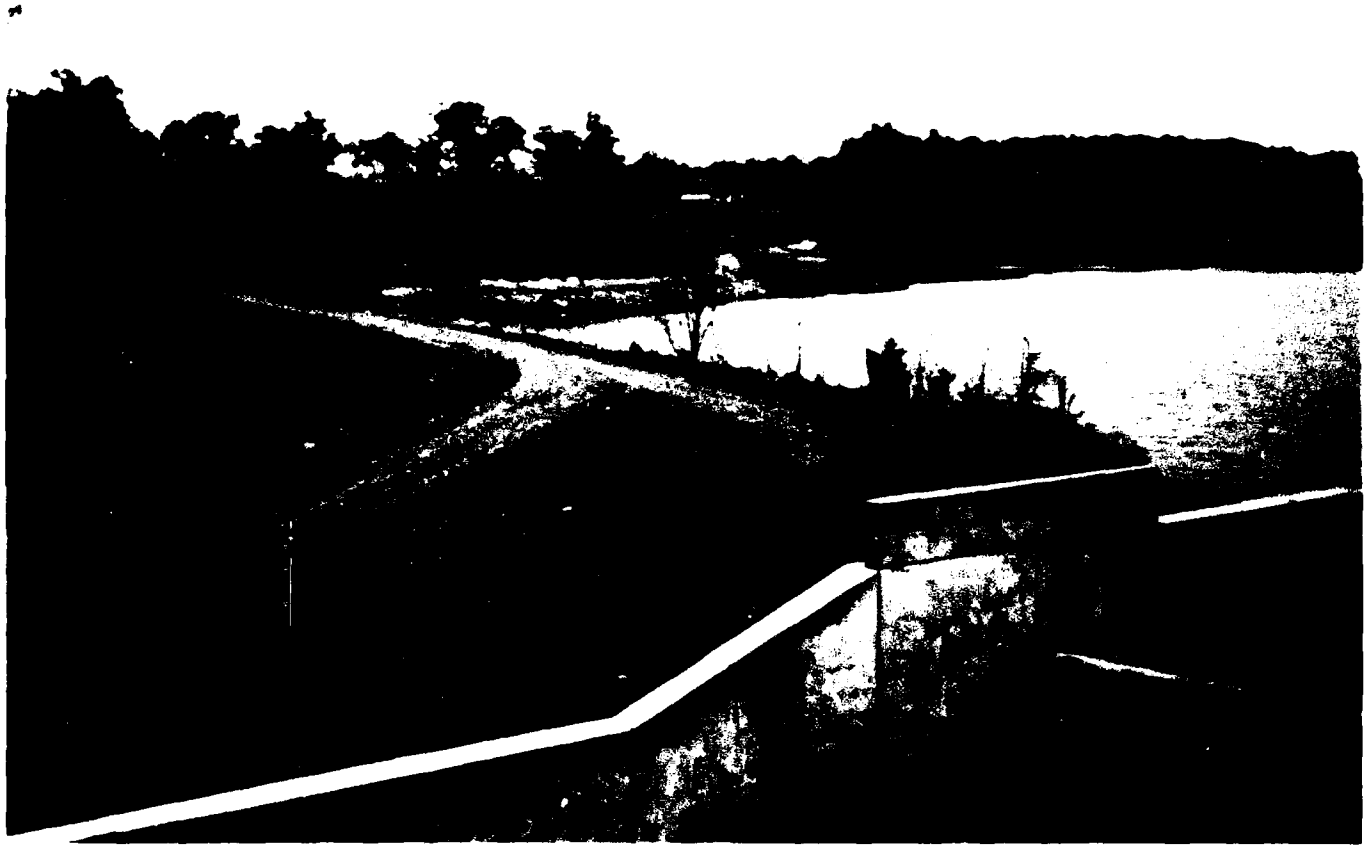
In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

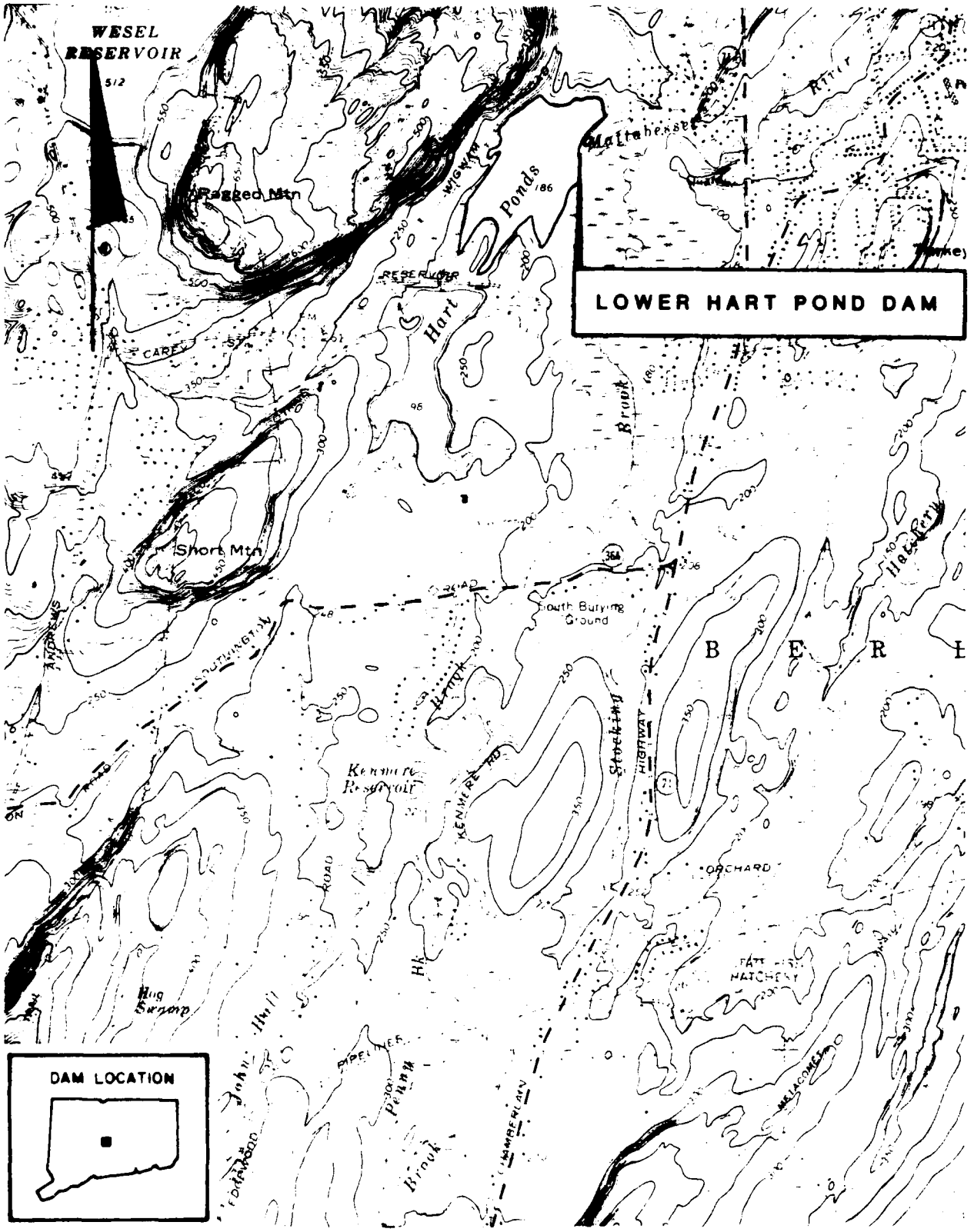
Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the Spillway Test Flood is based on the estimated Probable Maximum Flood for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and variety of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Inspection does not include an assessment of the need for fences, gates, "no trespassing" signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with Occupational Safety and Health Administration's (OSHA) rules and regulations is also excluded.

TABLE OF CONTENTS



LOWER HART POND DAM



QUADRANGLE: MERIDEN, CT

US ARMY, CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASS.

SCALE IN FEET
2000' 0 2000' 4000'
1" = 2000'

LOCATION MAP

PHASE I INSPECTION REPORT

LOWER HART POND DAM CT 00247

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspections throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Storch Engineers has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Storch Engineers under a letter of October 30, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0035 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection -

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location - Lower Hart Pond Dam is situated just north of Reservoir Road approximately 1/2 mile west of Route 71A in the Town of Berlin, Hartford County, Connecticut (See Location Map). The dam is located on the Mattabasset

River in the Connecticut River Basin. The coordinates of the dam are approximately 41°-37.15' north latitude and 72°-48.15' west longitude.

b. Description of Dam and Appurtenances - Lower Hart Pond Dam is an earth embankment that is approximately 1,420 feet long and 17.8 feet high. The embankment slope on both the upstream and downstream faces is 2.5:1. The upstream face is protected with modified riprap, the downstream face is covered with grass. An unpaved road runs along the crest.

The spillway is located approximately 500 feet from the north end of the dam and consists of a 30-foot long concrete weir. The south side of the spillway channel has a concrete retaining wall and the north side is bedrock. The length of the channel is approximately 100 feet.

A gate on the upstream face of the spillway weir controls a 12-inch discharge pipe that passes through the base of the spillway. Two 12-inch low-level discharge pipes pass through the base of the dam with control gates in two manholes located on the downstream slope of the embankment. Since the gates were put in they have never been used.

c. Size Classification - Lower Hart Pond Dam has a maximum height of 17.8 feet and a maximum storage capacity of 445 acre-feet at the top of the dam. In accordance with the Recommended Guidelines for Safety Inspection of Dams established by the Corps of Engineers, the dam is classified as SMALL (height less than 40 feet, storage less than 1,000 acre-feet).

d. Hazard Classification - Lower Hart Pond Dam is classified as having a HIGH hazard potential. Failure of the dam could result in the loss of more than a few lives and cause significant property damage. Approximately 3,400 feet downstream, the flood wave would strike three houses. The first floor sills of the houses are approximately 21 feet above the streambed. Estimated flows and

water depths at this location just prior to dam failure is 1,200 cfs and 10.5 feet and just after dam failure is 8,420 cfs and 23.7 feet. Therefore, the water level would rise approximately 2.7 feet above each first floor sill.

e. Ownership - Lower Hart Pond Dam is owned by the City of New Britain, Connecticut. The mailing address is:

New Britain Water Department
1000 Shuttle Meadow Avenue
New Britain, Connecticut 06052

f. Operator - The person in charge of the day-to-day operation of the dam is:

Mr. Harold Olsen
New Britain Water Department
1000 Shuttle Meadow Avenue
New Britain, Connecticut 06052

g. Purpose of Dam - The dam impounds Lower Hart Pond which is used for water supply by the City of New Britain.

h. Design and Construction History - Lower Hart Pond Dam was constructed around 1920. No original construction information is available. In 1971, the dam was reconstructed by Piedmont Construction, Newington, Connecticut. Design was performed by Malcolm Pirnie Engineers, White Plains, New York. Design information is available from the Owner.

i. Normal Operational Procedure - Water level in Lower Hart Pond is controlled by flow over the spillway. The only periodic dam maintenance is grass cutting.

1.3 Pertinent Data

a. Drainage Area - The Lower Hart Pond drainage basin is located in the Towns of Berlin and Southington and is irregular in shape. The area of the drainage basin is 2.0 square miles (Appendix D - Plate 3). Approximately 15 percent of the drainage basin is natural storage and approximately 90 percent is

undeveloped. The topography is rolling with elevations ranging from 760 (NGVD) to 187 (NGVD) at the spillway crest.

b. Discharge at Damsite - There are no records available for discharge at the dam.

(1)	Outlet works (conduit) size:	12 inches
	Invert elevation (feet above NGVD):	180.0
	Discharge Capacity at top of dam:	10 cfs
(2)	Maximum known flood at damsite:	unknown
(3)	Ungated spillway capacity at top of dam:	1,200 cfs
	Elevation (NGVD):	191.8
(4)	Ungated spillway capacity at test flood elevation:	320 cfs
	Elevation (NGVD):	189
(5)	Gated spillway capacity at normal pool elevation:	N/A
	Elevation (NGVD):	N/A
(6)	Gated spillway capacity at test flood elevation:	N/A
	Elevation (NGVD):	N/A
(7)	Total Spillway capacity at test flood elevation:	320 cfs
	Elevation (NGVD):	189
(8)	Total project discharge at top of dam:	1,210 cfs
	Elevation (NGVD):	191.8
(9)	Total project discharge at test flood elevation:	330 cfs
	Elevation (NGVD):	189

c.	Elevation (feet above NGVD)	
	(1) Streambed at toe of dam:	174
	(2) Bottom of cutoff:	none
	(3) Maximum tailwater:	176
	(4) Normal pool:	187
	(5) Full flood control pool:	N/A
	(6) Spillway crest (ungated):	187.0
	(7) Design surcharge	188.7
	(8) Top of dam:	191.8
	(9) Test flood surcharge:	189.0
d.	Reservoir (length in feet)	
	(1) Normal pool:	3,000
	(2) Flood control pool:	N/A
	(3) Spillway crest pool:	3,000
	(4) Top of dam:	3,200
	(5) Test flood pool:	3,100
e.	Storage (acre-feet)	
	(1) Normal pool:	245
	(2) Flood control pool:	N/A
	(3) Spillway crest pool:	245
	(4) Top of dam:	825
	(5) Test flood pool:	382
f.	Reservoir Surface (acres)	
	(1) Normal pool:	50
	(2) Flood control pool:	N/A
	(3) Spillway crest:	50

	(4) Test flood pool:	52
	(5) Top of dam:	55
g.	Dam	
	(1) Type:	earth embankment
	(2) Length:	1,420 feet
	(3) Height:	17.8 feet
	(4) Top width:	12 feet
	(5) Side slopes:	2.5:1
	(6) Zoning:	none
	(7) Impervious core:	none
	(8) Cutoff:	none
	(9) Grout curtain:	none
	(10) Other:	N/A
h.	Diversion and Regulating Tunnel:	N/A
i.	Spillway	
	(1) Type:	concrete-ogee
	(2) Length of weir:	30 feet
	(3) Crest elevation	187.0
	(4) Gates:	N/A
	(5) U/S Channel:	30 feet wide
		30 feet long
	(6) D/S Channel:	30 feet wide
		100 feet long
	(7) General:	N/A
j.	Regulating Outlets	
	(1) Invert elevation (NVGD):	180.0
	(2) Size:	12 inches

(3)	Description:	two cast iron pipes
(4)	Control Mechanism:	manually operated gate
(5)	Other:	gate never operated

SECTION 2 - ENGINEERING DATA

2.1 Design Data

There are no design computations or drawings available for the original dam; however, there are drawings of the dam reconstruction of 1971. These drawings show plans and sections of the dam as well as details of the spillway. The drawings were prepared by Malcolm Pirnie Engineers, White Plains, New York.

2.2 Construction Data

The original dam was constructed around 1920 and reconstructed in 1971. The reconstruction was done by Piedmont Construction, Newington, Connecticut. There are no records available for either the original construction or the reconstruction of the dam.

2.3 Operation Data

The gates for the low-level discharge pipes have never been operated, and it is not known if they can operate properly. The discharge pipes through the dam are under a constant head at all times.

2.4 Evaluation of Data

a. Availability - There were no computations available, however, drawings of the reconstruction are available. These drawings can be obtained from the Water Department, City of New Britain.

b. Adequacy - The information made available along with the visual inspection, past performance history and hydraulic/hydrologic computations were adequate to assess the condition of the facility.

c. Validity - The drawings were assumed to be based on a valid design and the visual inspection verified that at least the outer limits and appurtenant structures of the dam were built as shown on the drawings.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General - The visual inspection was conducted on October 21, 1980 by members of the engineering staff of Storch Engineers, D. Baugh and Associates, Inc. and Matthews Associates with the help of Mr. Harold Olson of the New Britain Water Department. A copy of the visual inspection checklist is contained in Appendix A of this report. Selected photos of the dam and appurtenant structures are contained in Appendix C.

In general, the overall appearance and condition of the facility and its appurtenant structures is FAIR.

b. Dam - The dam is an earth embankment. The downstream face is well vegetated with grass and some brush (Photos 1 and 3) and the slopes are 2.5:1. Along the toe of the dam, there are trees and brush which obscured the view of the toe (Photos 1 and 3). The upstream face is in good condition with no signs of distress. Also, there are several areas on the upstream embankment where brush and small trees are growing (Photos 1 and 2). The riprap protection shows no signs of erosion or sloughing (Photo 2). Along the southern abutment of the spillway and on the upstream face of the dam, there is evidence of erosion from rain water running off the top of the dam. The top of the dam is level with no signs of settlement.

Just below the toe of the dam and in the vicinity of the outlet of the low-level discharge pipes, there is a seepage flow (Photo 4), the amount of which could not be determined (See Photo Location Map - Plate 3 for location). This flow is clear and shows no signs of particle movement. Also, the outlet of the low-level discharge pipes could not be found. However, in the approximate vicinity

where the outlet should be, according to the plans, there is now a depression (Photo 3 - See Location Map - Plate 3 for location).

c. Appurtenant Structures - There are two 12-inch low-level discharge pipes that to pass through the base of the dam. Controls for these pipes are in manholes on the downstream side of the embankment. The location of the outlets could not be found. There is also a discharge pipe through the spillway, but the inlet is silted up and its condition unknown (Plate 2 - Spillway and Drain Detail, Photo 8).

The spillway is a concrete ogee weir that is in fair condition (Photos 5 through 9). The downstream channel is a bedrock channel that is 30 feet wide. The south side of the channel has a concrete training wall approximately 100 feet long. The downstream side of the spillway is being undermined and an attempt to correct the problem with concrete has been made (Photo 6). There is also some undermining at the spillway's north abutment (Photo 7). The downstream spillway training wall is in fair condition and in one spot it to is being undermined (Photo 5).

d. Reservoir Area - The area immediately adjacent to the facility is gently sloped and in a natural state. The shoreline shows no signs of sloughing or erosion. There is no development adjacent to the reservoir. A rapid rise in the water level of the reservoir will not endanger any life or property.

e. Downstream Channel - The spillway channel is not well defined and is overgrown (Photo 10).

3.2 Evaluation

Overall, the general condition of the dam is fair. The visual inspection revealed items that lead to this assessment such as:

a. Seepage through the embankment in the vicinity of the low-level discharge pipes and along the toe;

b. Inoperable low-level discharge pipes;

c. A depression at the outlet of the discharge pipes;

d. Vegetation on the upstream and downstream face and along the toe of the dam;

e. Undermining of the spillway and training wall.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General - The operation of this facility is for water supply and the reservoir is kept at or above the spillway crest. The water is pumped to Wesel Reservoir. The twin 12-inch low-level discharge pipes through the dam have never been used and their condition is unknown. The 12-inch discharge pipe through the spillway has no apparent use. Water levels are observed on a daily basis and more frequently during heavy rain.

b. Description of any Warning System in Effect - There is no warning system in effect for this dam.

4.2 Maintenance Procedures

a. General - Only grass is cut on a regular basis.

b. Operating Facilities - Gates at the dam have never been operated.

4.3 Evaluation

The maintenance of the dam is less than adequate in that proper care of the dam embankment should be on a regular basis. Gates should be maintained in working order and there should be a proper operating procedure and warning system in effect.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Lower Hart Pond Dam is an earth embankment approximately 1,420 feet long and 17.8 feet high. The spillway is a concrete ogee weir, 30 feet long. The downstream channel is 30 feet wide and is bedrock with a concrete wall. Twin 12-inch discharge pipes pass through the base of the dam. The gates to the discharge pipes have never been used.

The watershed encompasses 2.0 square miles and is 90 percent undeveloped. Water flowing into Lower Hart Pond is controlled by Upper Hart Pond and when Wesel Reservoir was constructed, the flow from its drainage area was diverted into another basin. The topography is rolling with the terrain rising 575 feet from the spillway crest.

The pond has a total capacity of approximately 245 acre-feet at the spillway crest and approximately 825 acre-feet at the top of the embankment.

5.2 Design Data

Design data for the dam is available from the New Britain Water Department. Data includes hydraulic/hydrologic computations by Malcolm Pirnie Engineers.

5.3 Experience Data

Since the dam was rebuilt in 1971 it has experienced the major storms of January and February 1978 and January 1979. The flood of record in the Berlin area resulted from the storm of September, 1938. The reconstructed dam has never been overtopped.

5.4 Test Flood Analysis

Based on the guidelines found in the Recommended Guidelines for Safety Inspection of Dams, the dam is classified as a SMALL structure with a HIGH

hazard potential. The test flood for these conditions ranges from 1/2 the PMF to the PMF. One-half the PMF was used because of the dams small size.

Using guide curves established by the Corps of Engineers (rolling terrain), the test flood inflow is 1,435 cfs. The routing procedure established by the Corps' guidelines gives an approximate outflow of 1,020 cfs. The spillway capacity of the dam is approximately 1,200 cfs or 117 percent of the routed test flood outflow. The test flood will not overtop the dam and will have 0.4 feet of freeboard.

In the development of the test flood inflow, it was assumed that the peak outflow from Upper Hart Pond Dam and the peak runoff from the independent watershed occurred at the same time. This simplified the development of the peak inflow, the routing through the dam and the peak outflow for Lower Hart Pond Dam.

The pond is used for water supply and because of this the water level is kept high as possible, therefore the storage behind the dam was assumed to begin at the spillway crest. Storage capacity and discharge curves were obtained from the New Britain Water Department records.

5.5 Dam Failure Analysis

A dam failure analysis was performed using the Rule of Thumb method in accordance with guidelines established by the Corps of Engineers. Failure was assumed to occur when the water level in the reservoir was at the top of the dam.

The spillway discharge just prior to dam failure is 1,200 cfs and the calculated dam failure discharge is 20,200 cfs.

Failure of Lower Hart Pond Dam could result in the loss of more than a few lives and cause significant property damage. Approximately 3,400 feet downstream, the flood wave would strike three houses. The first floor sill of the

houses are approximately 21 feet above the streambed. Estimated flow and water depth at this location just prior to dam failure is 1,200 cfs and 10.5 feet and just after dam failure is 8,420 cfs and 23.7 feet. Therefore, the water level would rise approximately 2.7 feet above each first floor sill. High depths of flow at this location are a consequence of the culvert under Route 71.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The general structural stability of the dam is good as evidenced by the vertical, horizontal and lateral alignment of the embankment. The embankment has a good vegetative cover and the riprap protection on the upstream face is in good condition. The spillway channel is in fair condition with several areas that are being undermined. Presently, this condition is not detrimental to the spillway structure, but continued undermining will create future problems.

A possible problem area is the pressurized twin 12-inch low-level discharge pipes. Controls for these gates should be on the upstream side of the embankment and not on the downstream side. Also at the outlet of the twin 12-inch low-level discharge pipes there is a depression in the embankment. The cause of this depression should be determined.

6.2 Design and Construction Data

The only construction data available was in the form of drawings. Design computations can be obtained from the designer. No construction reports are available.

6.3 Post-Construction Changes

Since its reconstruction in 1971, no post-construction changes have been made.

6.4 Seismic Stability

The dam is located in Seismic Zone 1 and in accordance with Recommended Phase I Guidelines does not warrant a seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - After considering the available information, the results of the inspection, contacts with the owner and hydraulic/hydrologic computations, the general condition of the Lower Hart Pond Dam is FAIR.

b. Adequacy of Information - The information available is such that an assessment of the safety of the dam was based on the available data, the visual inspection results, past operational performance of the dam and its appurtenant structures and computations developed for this report.

c. Urgency - It is considered that the recommendations suggested below should be implemented within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations

The following recommendations should be carried out under the direction of a qualified registered engineer.

a. Seepage through the dam embankment in the vicinity of the low-level discharge pipe and along the toe of the dam should be investigated further to determine its origin and monitored to determine any changes.

b. The cause of the depression and the potential for piping or sloughing of the embankment at the outlet of the discharge pipe should be studied.

c. Trees including stumps and root systems should be removed from the embankment slopes and within 20 feet of the toe and backfilled with proper material.

d. The feasibility of putting the control gate to the discharge pipe on the upstream side of the dam should be studied.

e. The cause and extent of the undermining of the spillway and training wall should be investigated.

7.3 Remedial Measures

a. Operation and Maintenance Procedures -

(1) Grass should be maintained and brush should be removed on the upstream and downstream face of the dam This will facilitate the visual observation of existing and potential seepage.

(2) Brush and debris should be removed from the spillway discharge channel.

(3) Discharge gate and pipe should be operated to determine its condition.

(4) Erosion from water running off the top of the dam, adjacent to the south spillway abutment, should be corrected by raising the ground to the proper grade with a compacted topsoil base and by establishing a tight grass cover.

(5) A formal downstream warning system should be put into operation for use in the event of an emergency.

(6) Plans for a regular program of operation and maintenance at the dam should be initiated.

(7) A program of annual technical inspection should be established.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Lower Hart Pond Dam

DATE 11/26/80

TIME 10:00 a.m.

WEATHER Overcast, low 60's

W.S. ELEV.____ U.S.____ DN.S.

PARTY:

1. Gary Giroux, SE, Hyd./Struct.
2. Ken Pudeler, SE, Civil
3. Ben Cohen, SE, Civil
4. Mike Pozzato, MA, Mech.
5. Floyd Austin, DBA, Civil
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam Embankment	K. Pudeler F. Austin	Fair
2.	Mechanical	M. Pozzato	Condition Unknown
3.	Spillway	G. Giroux B. Cohen	Fair
4.	Discharge Channel	G. Giroux B. Cohen	Good
5.			
6.			
7.			
8.			
9.			
10.			

INSPECTION CHECK LIST

PROJECT Lower Hart Pond Dam DATE 11/26/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	191.8 (NGVD)
Current Pool Elevation	182.0 (NGVD)
Maximum Impoundment to Date	Unknown
Surface Cracks	N/A
Pavement Condition	N/A
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes Vegitation on Slopes Sloughing or Erosion of Slopes or Abutments	Problem Many 2-3' stumps in upstream embankment Erosion around south spillway abutment and undermining of north spillway abutment
Rock Slope Protection - Riprap Failures	None
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	Pond water level down but swamp grass along downstream toe at many locations. One spot where water was seeping
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

INSPECTION CHECK LIST

PROJECT Lower Hart Pond Dam DATE 11/26/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
CUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	N/A
a. Approach Channel	
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

INSPECTION CHECK LIST

PROJECT Lower Hart Pond Dam DATE 11/26/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	N/A
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	Manually operated gate regulates low level discharge pipe below spillway. Gate inoperable - partially buried under riprap.
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

INSPECTION CHECK LIST

PROJECT Lower Hart Pond Dam DATE 11/26/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	N/A
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

INSPECTION CHECK LIST

PROJECT Lower Hart Pond Dam DATE 11/26/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Good
b. Weir and Training Walls	
General Condition of Concrete	Good although north abutment undermined
Rust or Staining	Some staining
Spalling	Minimal
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Channel is dry-no evidence of seepage
Drain Holes	None
c. Discharge Channel	
General Condition	Good although erosion has exposed footing of south training wall
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Channel	None
Other Obstructions	None

INSPECTION CHECK LIST

PROJECT Lower Hart Pond Dam DATE 11/26/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	N/A
General Condition of Concrete	
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	
Channel	
Loose Rock or Trees Overhanging Channel	
Condition of Discharge Channel	

INSPECTION CHECK LIST

PROJECT Lower Hart Pond Dam DATE 11/26/80

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	N/A
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

APPENDIX B

ENGINEERING DATA

Any information pertaining to the history, maintenance and past inspection reports are located at:

State of Connecticut
Department of Environmental
Protection
Water Resources Unit
State Office Building
Hartford, Connecticut 06115

Plans are located at:

New Britain Water Department
City of New Britain
1000 Shuttle Meadow Avenue
New Britain, Connecticut 06052

LOWER HART POND

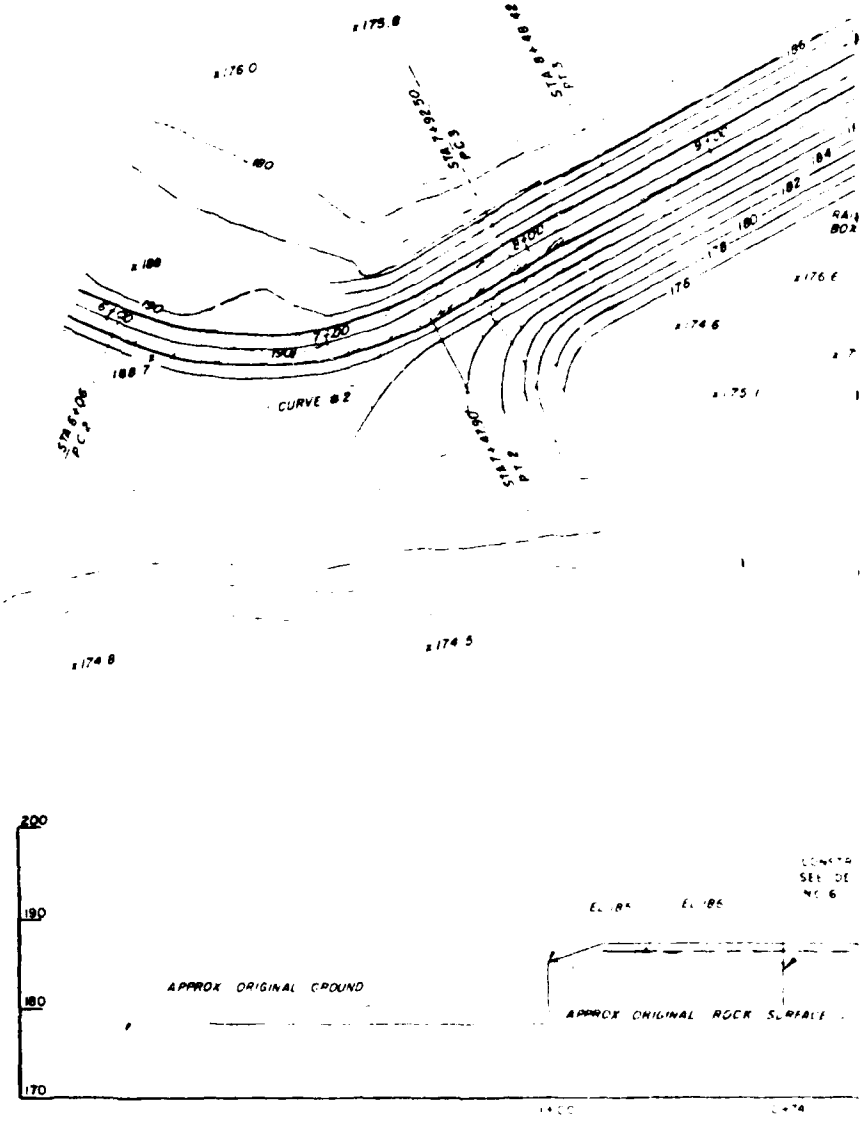
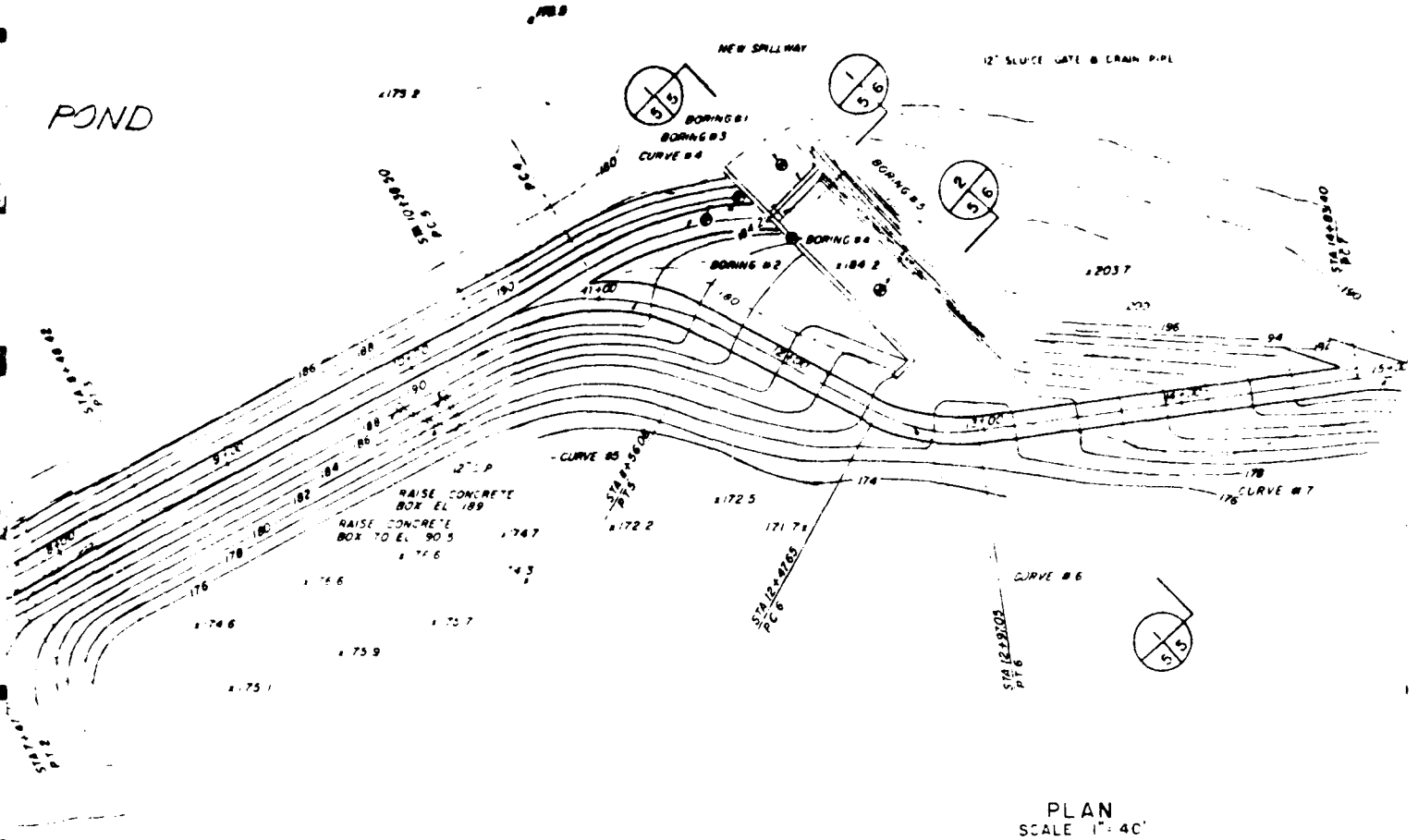
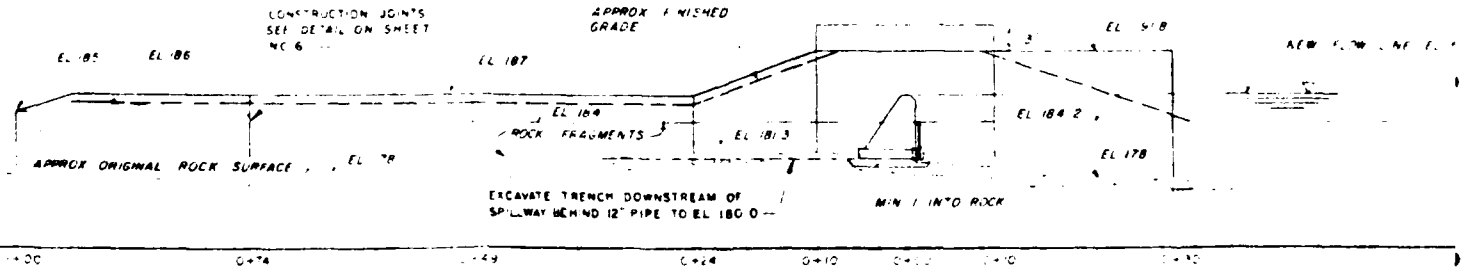


Plate 1



PLAN
SCALE 1" = 40'



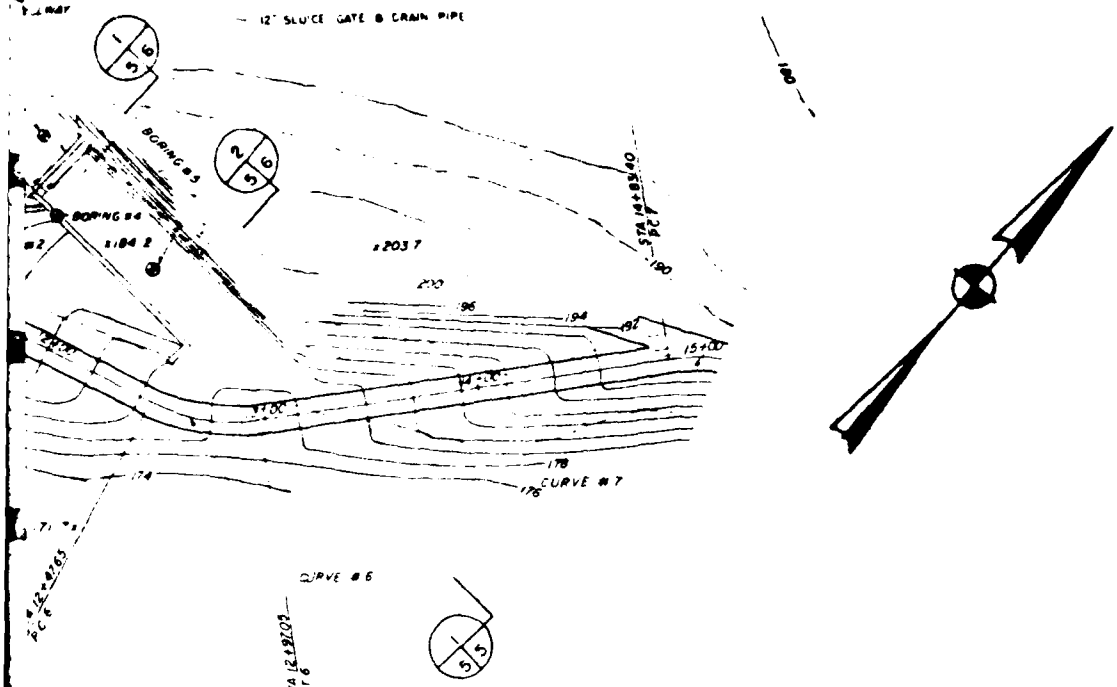
SPILLWAY CHANNEL PROFILE

STORCH ENGINEE
WETHERSFIELD,CONNEC

NATIONAL PROGRAM

LOW

PHOTO REDUCED - HALF SIZE
FROM PLANS PREPARED BY
MALCOLM PIRNIE ENGINEERS



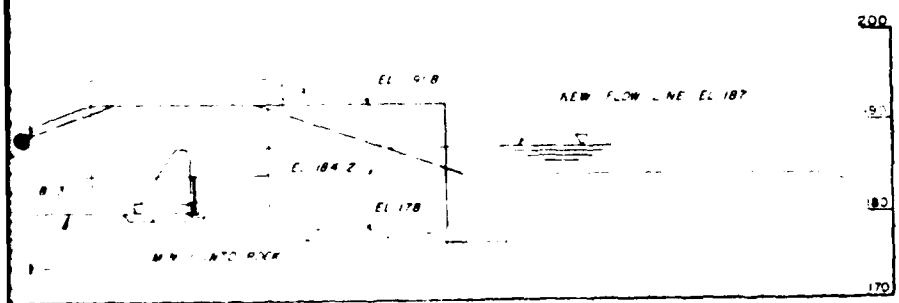


PLATE 1

STORCH ENGINEERS WETHERSFIELD, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

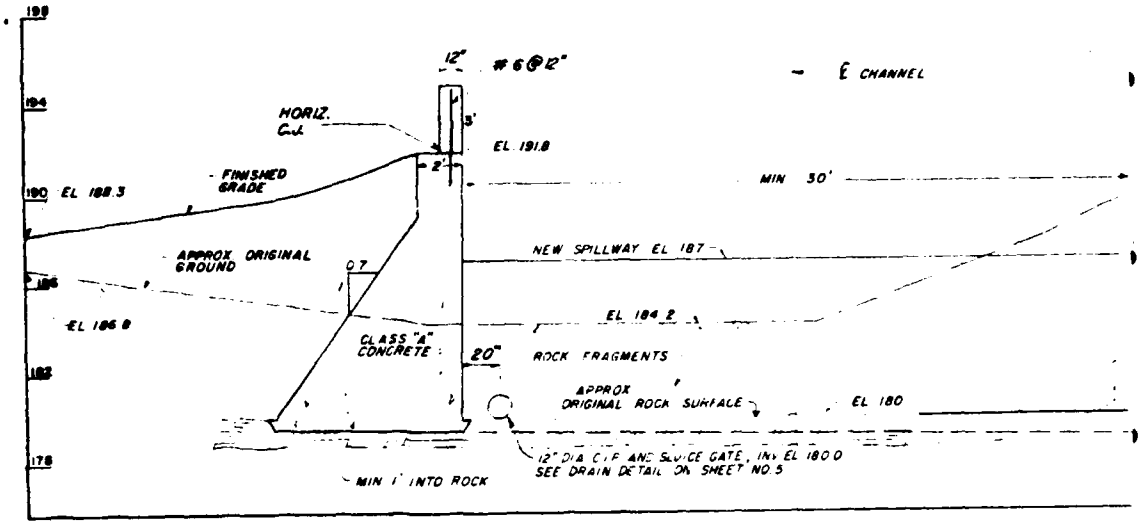
LOWER HART POND

SCALE AS SHOWN

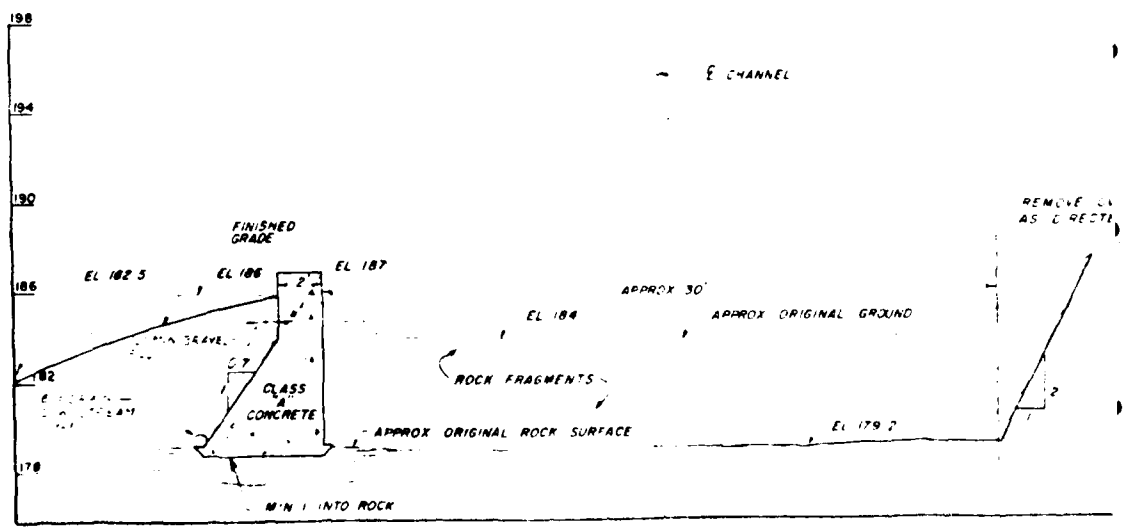
DATE FEBRUARY 1981

)FILE

ICED - HALF SIZE
PREPARED BY
RNIE ENGINEERS

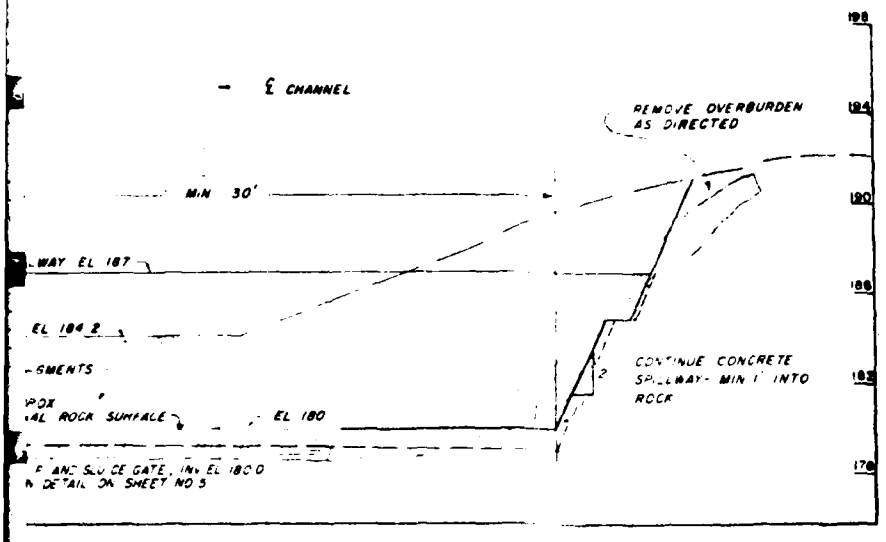


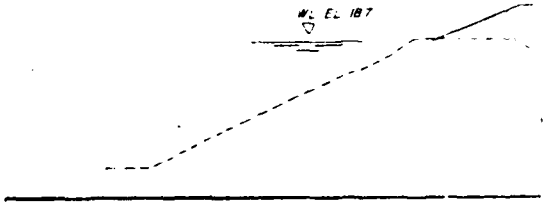
SPILLWAY CHANNEL



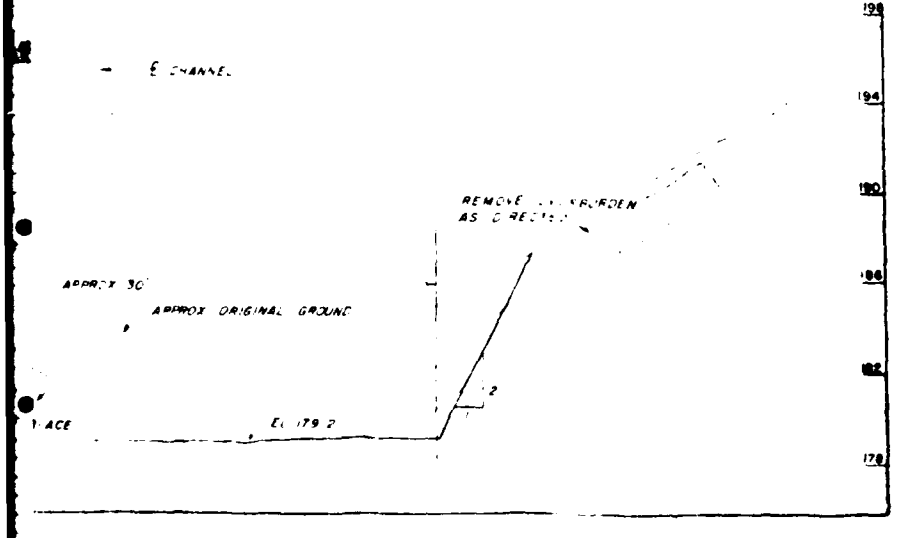
SPILLWAY CHANNEL

Plate 2





SPILLWAY CHANNEL

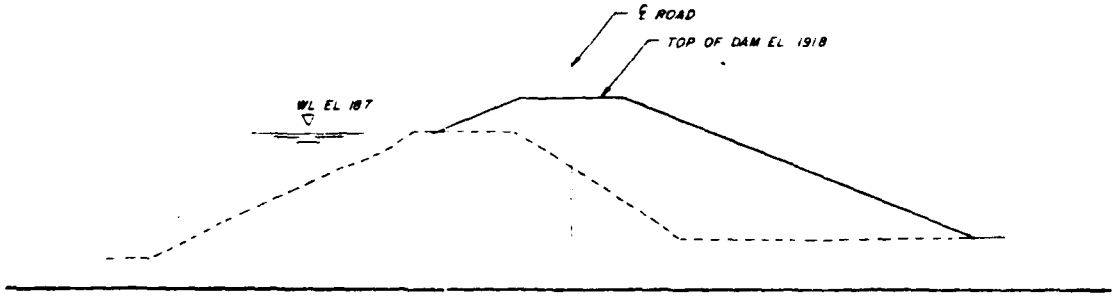


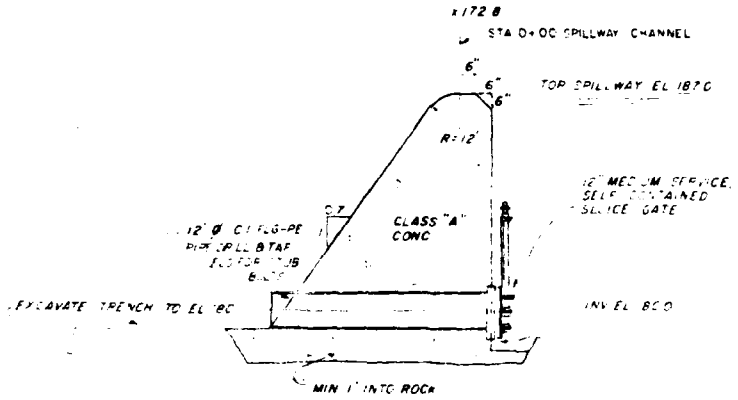
SPILLWAY

VAY CHANNEL

STORCH E
WETHERSFIE
NATIONAL PF

PHOTO REDUCED - HALF SIZE
FROM PLANS PREPARED BY
MALCOLM PIRNIE ENGINEERS





SPILLWAY AND DRAIN DETAIL
SCALE 3/8" = 1'-0"

PLATE 2

STORCH ENGINEERS WETHERSFIELD, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOWER HART POND

			SCALE: AS SHOWN
			DATE: FEBRUARY 1981

) REDUCED - HALF SIZE
PLANS PREPARED BY
LM PIRNIE ENGINEERS

APPENDIX C

PHOTOGRAPHS

LOWER HART POND

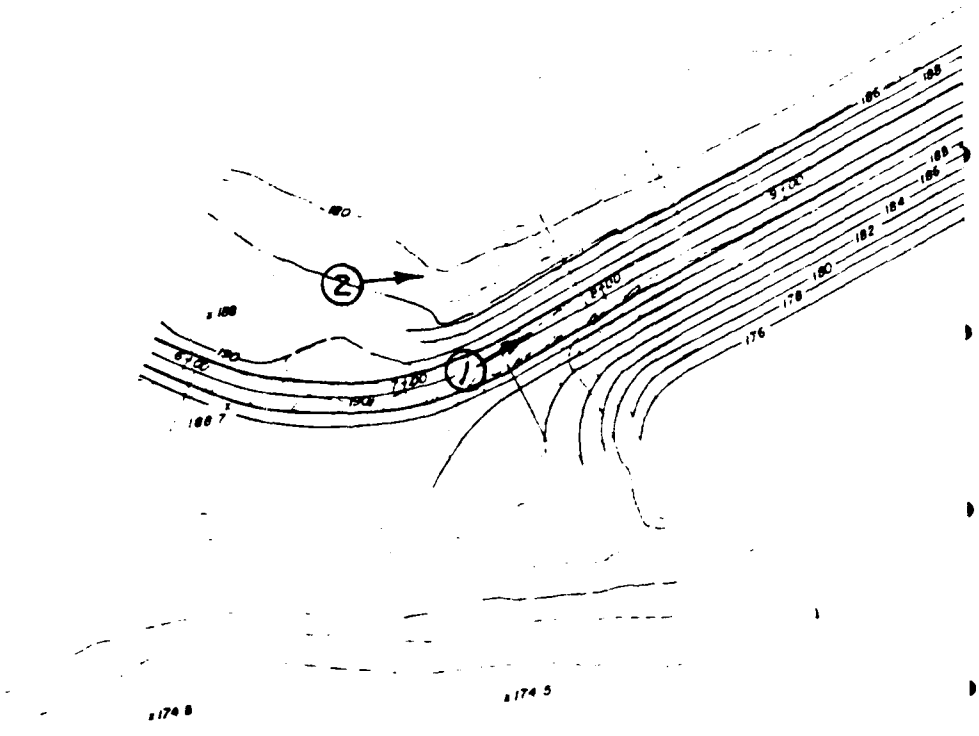
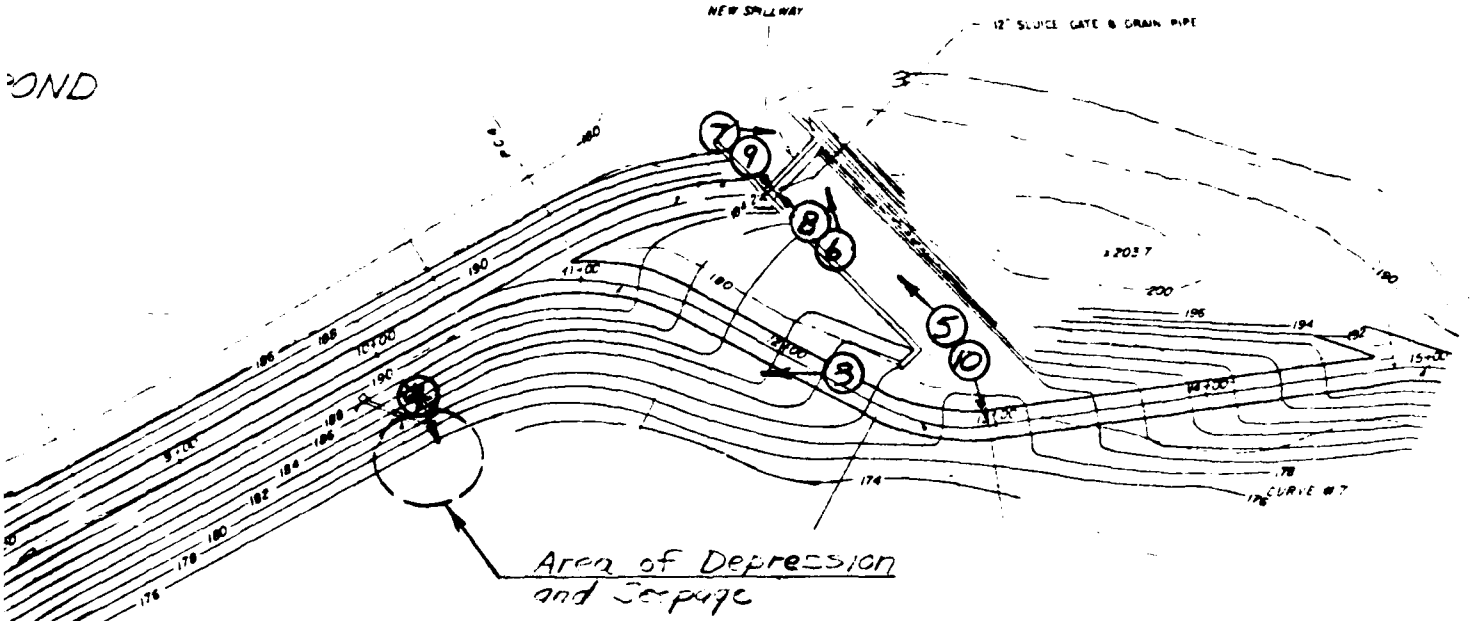


Plate 3

(1)

ND



PLAN
SCALE 1"= 40'

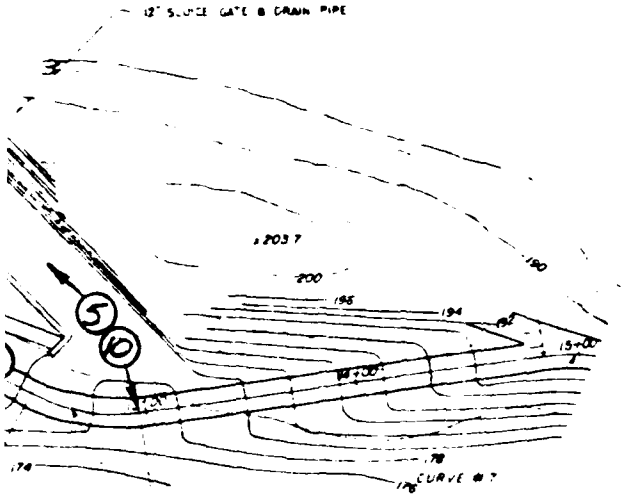
PHOTO LC

STORCH ENGINEE
WETHERSFIELD, CONNE

NATIONAL PROGRAI

LOW

(2) PHOTO REDUCED - HALF SIZE



PLAN
SCALE 1" = 40'

PHOTO LOCATION PLAN

PLATE 3

STORCH ENGINEERS WETHERSFIELD, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOWER HART POND

ICED - HALF SIZE

SCALE: AS SHOWN

DATE: FEBRUARY 1981

PHOTO 1

TOP OF DAM LOOKING NORTH

PHOTO 2

UPSTREAM FACE OF DAM

PHOTO 3

DOWNSTREAM FACE OF DAM

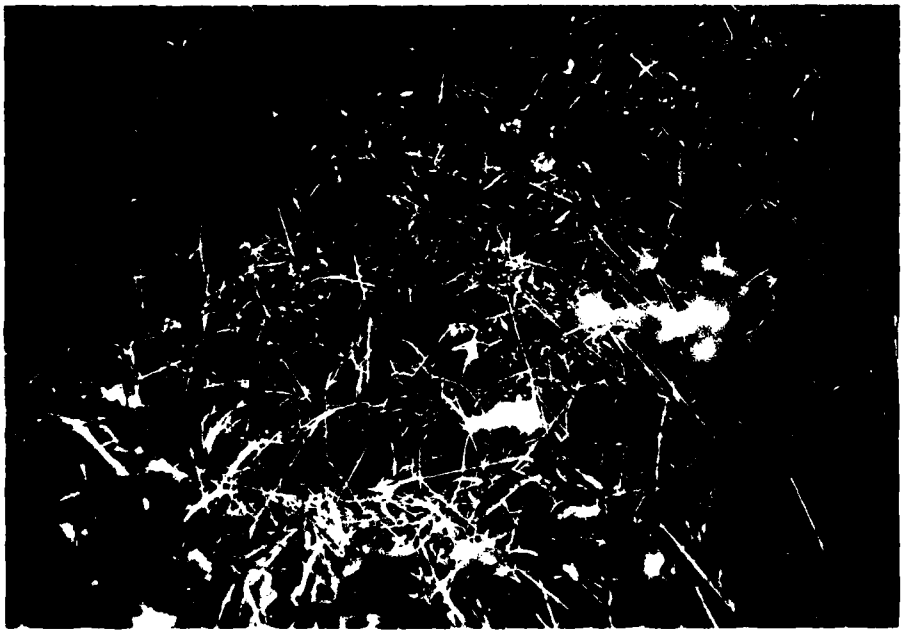


PHOTO 4

SEEPAGE - DOWNSTREAM FACE OF DAM

PHOTO 5

SPILLWAY - DOWNSTREAM FACE

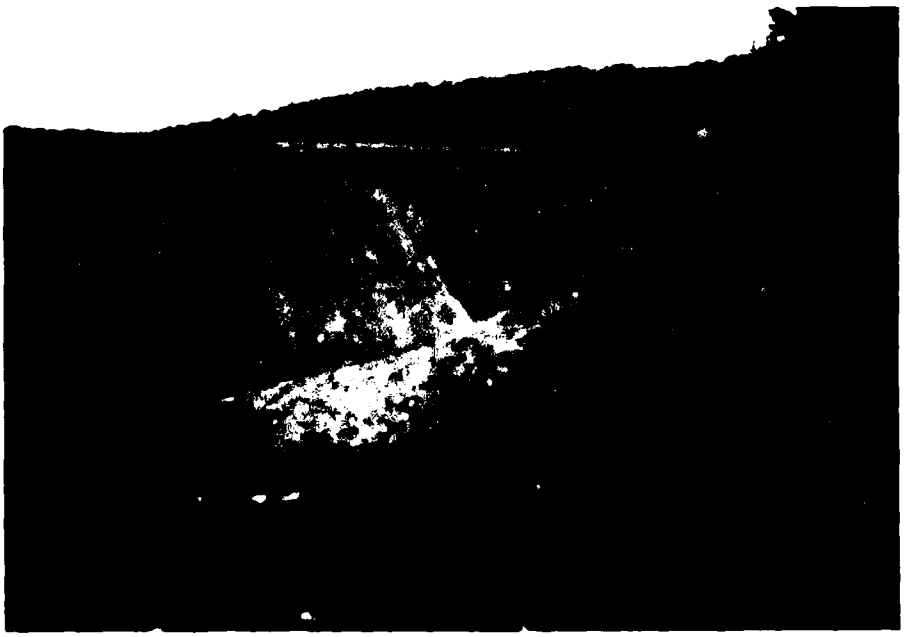


PHOTO 6

SPILLWAY - NORTH ABUTMENT - DOWNSTREAM FACE

PHOTO 7

SPILLWAY - NORTH ABUTMENT - UPSTREAM FACE

PHOTO 8

LOW LEVEL DISCHARGE - SPILLWAY

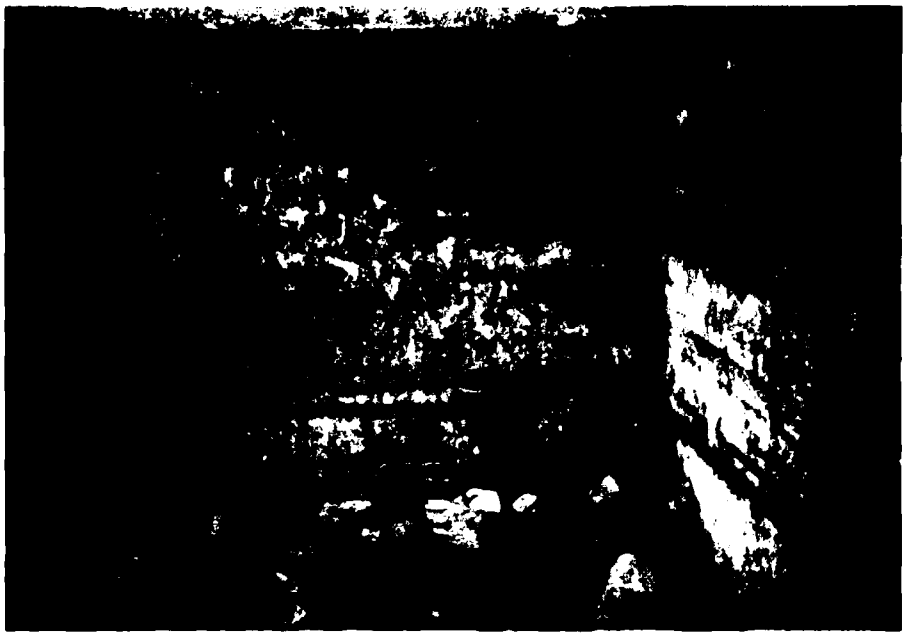


PHOTO 9

GATE STEM - LOW LEVEL DISCHARGE - SPILLWAY

PHOTO 10

DOWNSTREAM CHANNEL

APPENDIX D

HYDRAULIC AND HYDROLOGIC COMPUTATIONS

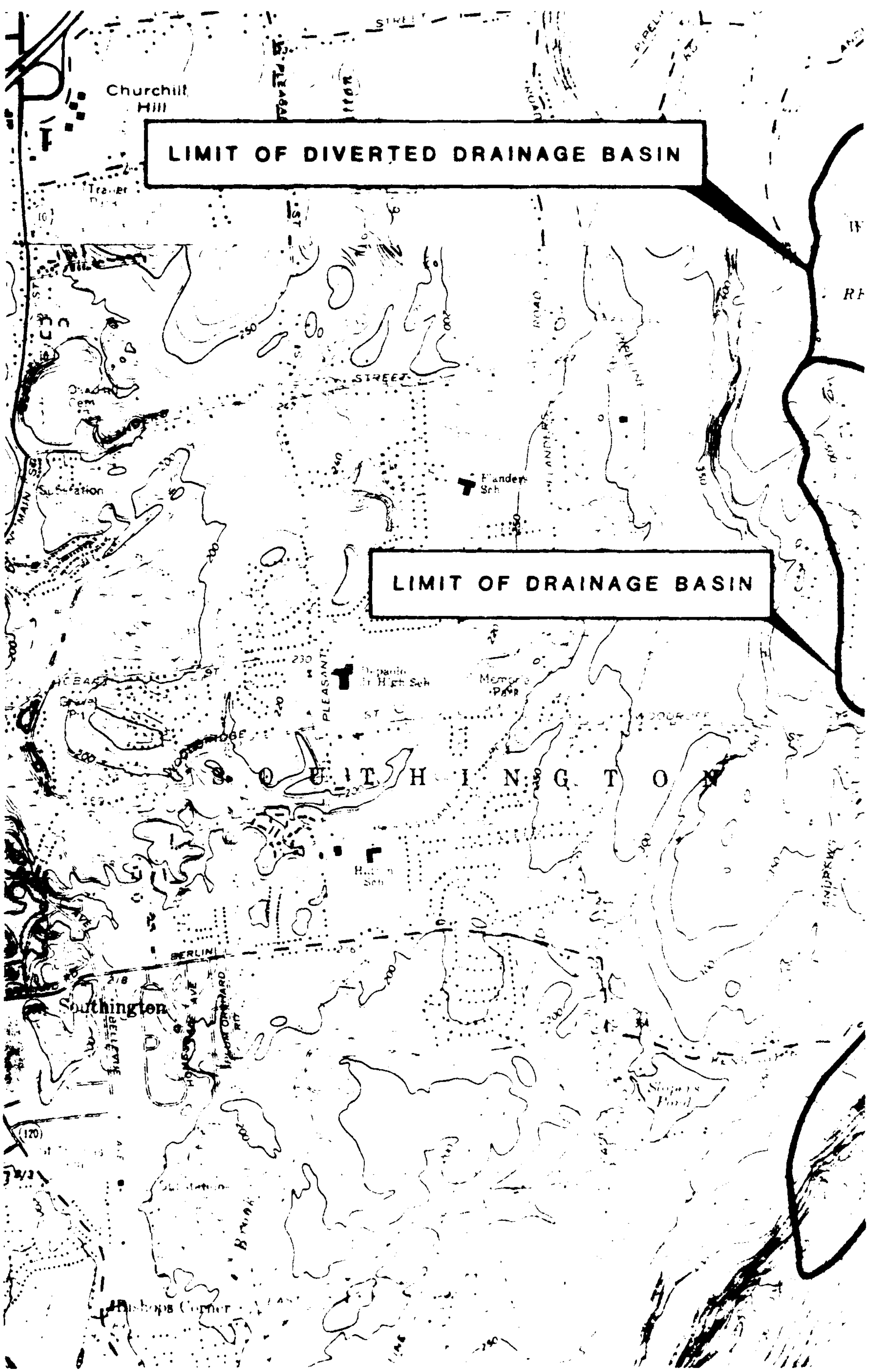

LIMIT OF DIVERTED DRAINAGE BASIN
LIMIT OF DRAINAGE BASIN
Churchill Hill
SOUTHINGTON
Southington
Flanders Sch
PLEASANT
STREET
BERLIN
MAIN ST
Substation
Gravel Pit
Memorial Park
Bishops Corner

Plate 4

1

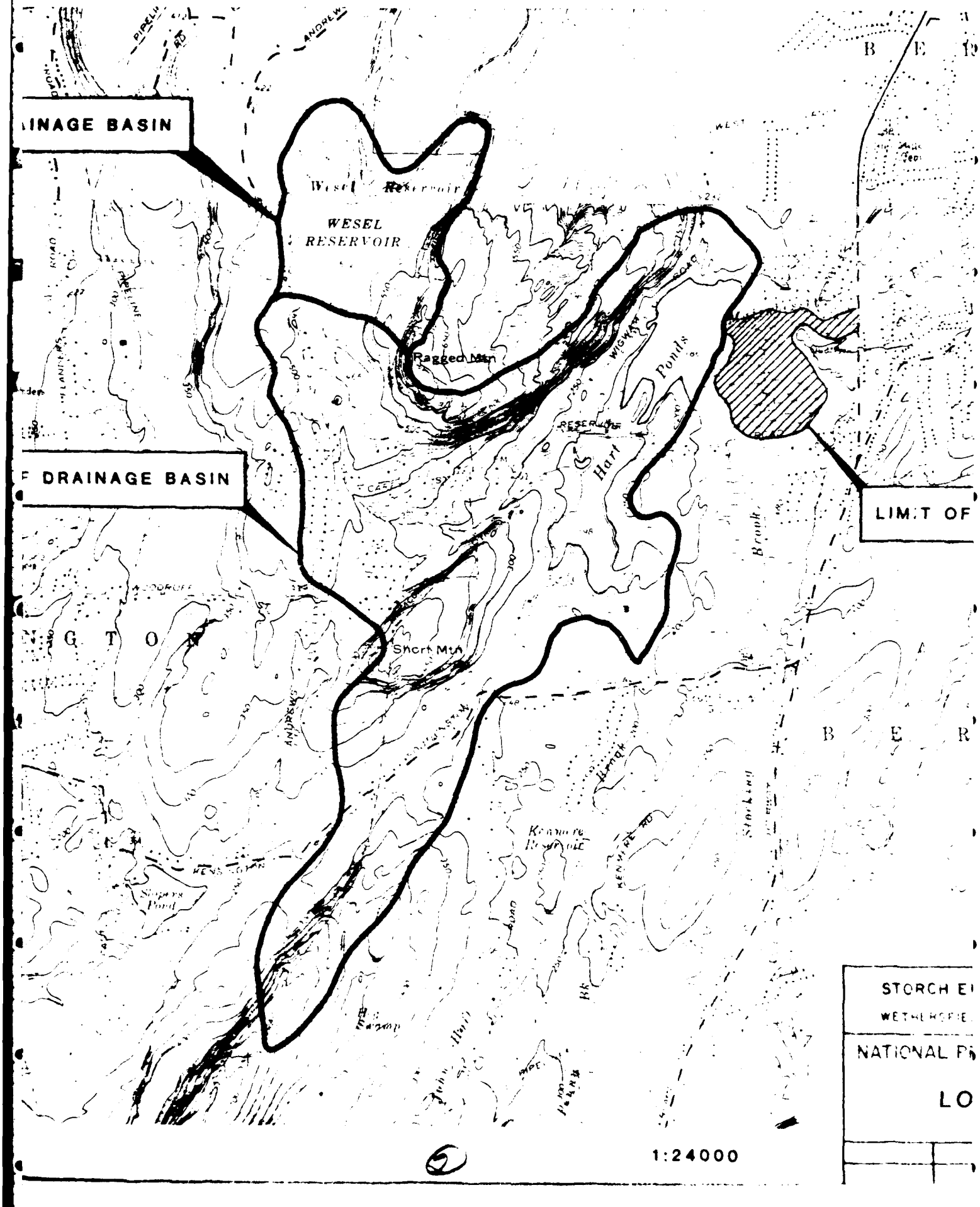

INAGE BASIN
F DRAINAGE BASIN
LIMIT OF
WESEL
RESERVOIR
Ragged Mtn
Hart
Ponds
Short Mtn
1:24000

PLATE 4

STORCH ENGINEERS WETHERSFIELD, CONNECTICUT	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

LOWER HART POND DAM

			SCALE AS SHOWN
			DATE FEBRUARY 1981

STORCH ENGINEERS
Engineers - Landscape Architects
Planners - Environmental Consultants

JOB Phase I Dam Inspection - #4463
SHEET NO _____ OF _____
CALCULATED BY GJG DATE 12/2
CHECKED BY SDC DATE 12/15/80

Determination of Test Flood

NAME OF DAM Upper Hart Pond Dam*

DRAINAGE AREA 1037 acres 1.62 SM

INFLOW Size: Hazard: Test Flood: 1/2 PMF

Inflow 2150/2 = 1075 cfs/SM

Q = 1075 × 1.6 = 1741 cfs

Estimating the effect of surcharge storage on the Maximum Test Flood

1. Q_{P1} = 1740 cfs
2a. H_1 = 8' (elev.)
b. $STOR_1$ = 6.2"
c. $Q_{P2} = Q_{P1}(1 - STOR_1/9.5)$ = 605 cfs
3a. H_2 = 3.9' $STOR_2$ = 2.65"
b. $STOR_A$ = 4.4"
Q_{PA} = 934 cfs
H_A = $STOR_A$ =

Test Flood = 934 cfs

Capacity of the spillway when the pond elevation is at the top of the dam

Q = _____ cfs or _____ % of the Test Flood

* Prior to routing the inflow through Lower Hart Pond it must be routed through Upper Hart Pond.

STORCH ENGINEERS
Engineers - Landscape Architects
Planners - Environmental Consultants

JOB Phase I Dam Inspection - #4463
SHEET NO _____ OF _____
CALCULATED BY GJG DATE 12/2/20
CHECKED BY BDC DATE 12/15/20

Determination of Test Flood

NAME OF DAM Lower Hart Pond Dam

DRAINAGE AREA 0.4 SM (independent) 2.0 SM (Total)

INFLOW Size: Small Hazard: High Test Flood: ½ PMF

assume inflow from Upper Hart Pond and Independant watershed peak simultaniously.

Inflow = 2500/2 = 1250 cfs/SM

$Q = 1250(.4) + 934 = 1435$ cfs

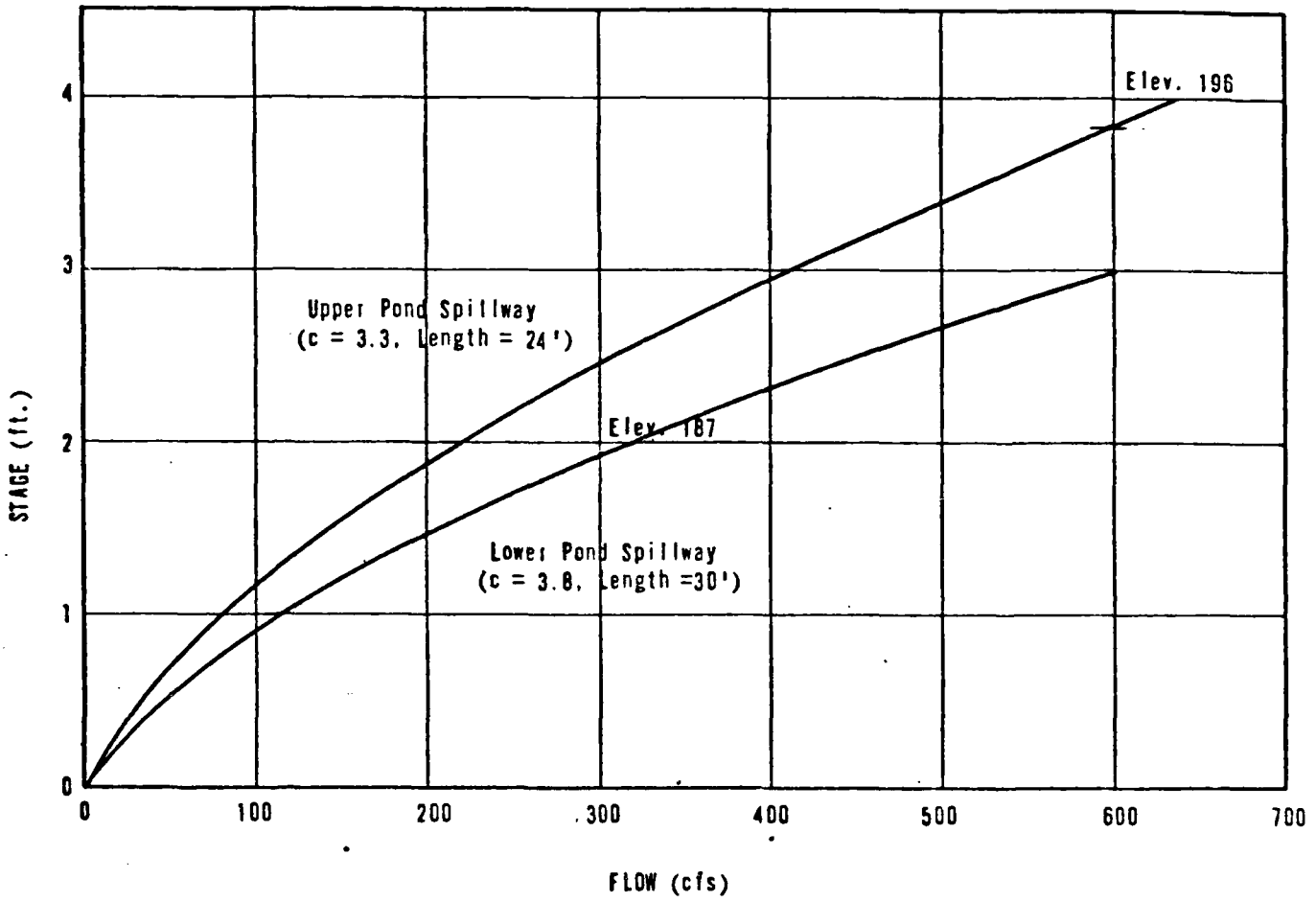
Estimating the effect of surcharge storage on the Maximum Test Flood

1. Q_{P1} = 1435 cfs
2a. H_1 = 5.5' (elev.)
b. $STOR_1$ = 3.2"
c. $Q_{P2} = Q_{P1}(1 - STOR_1/\ )$ = 906 cfs
3a. H_2 = 4' $STOR_2$ = 2.3"
b. $STOR_A$ = 2.75"
Q_{PA} = 1020 cfs
H_A = 4.4' $STOR_A$ = 2.6"

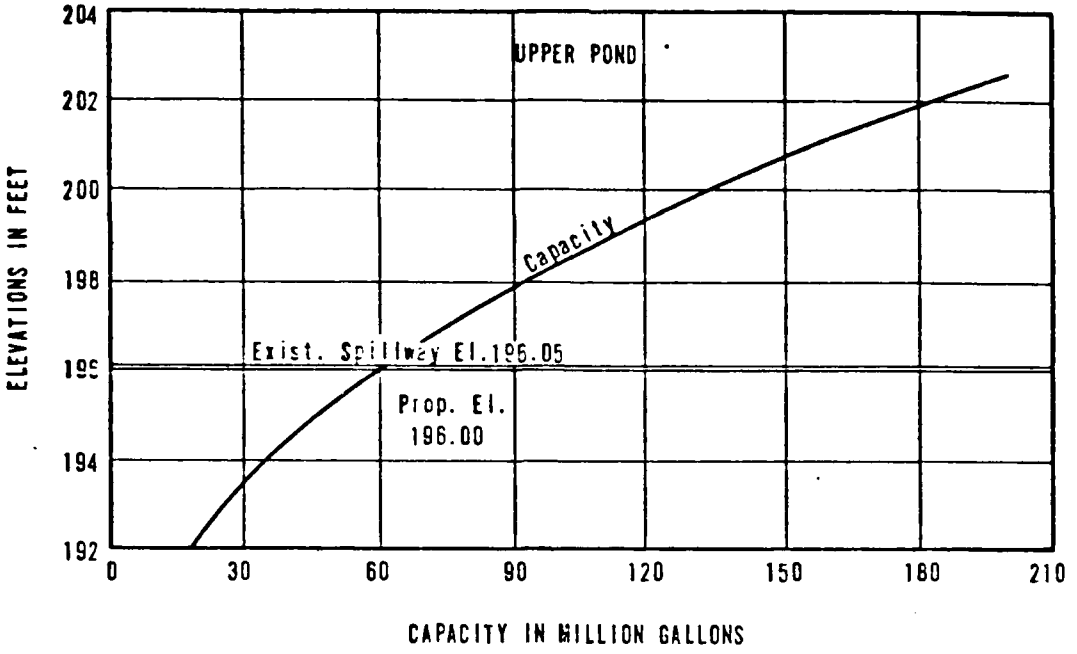
Test Flood = 1020 cfs

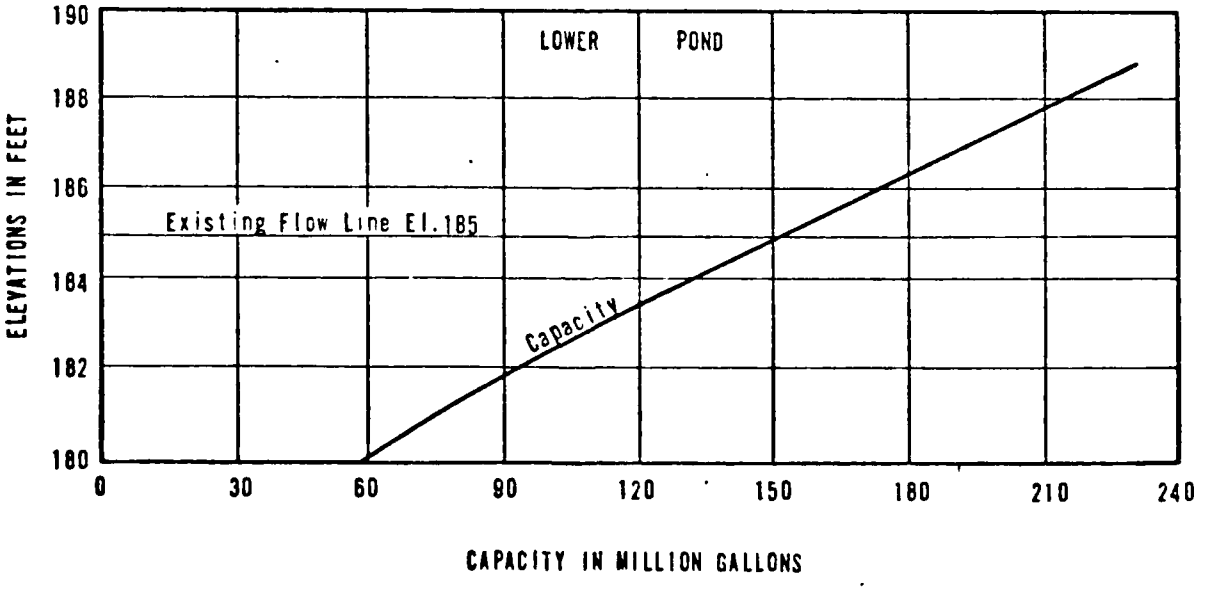
Capacity of the spillway when the pond elevation is at the top of the dam

Q = 1200 cfs or 117 % of the Test Flood



RATING CURVES FOR PROPOSED SPILLWAYS AT HART PONDS





STAGE-CAPACITY CURVES AT HART PONDS

STORCH ENGINEERS
Engineers · Landscape Architects
Planners · Environmental Consultants

JOB Phase I Dam Inspection - #4463
SHEET NO _____ OF _____
CALCULATED BY GJG DATE 10/29/80
CHECKED BY PDC DATE 12/5/80
Downstream Hydrographs

"Rule of Thumb" Guidance for Estimating Downstream Failure Hydrographs

NAME OF DAM Lower Harts Pond Dam

Section I at Dam

1. $S = \frac{825}{}$ Acft
2. $Q_{p1} = 8/27\ W_b \sqrt{g}\ Y^{3/2} = 8/27(160)\sqrt{32.2}\ (17.8)^{1.5} = 20,200$ cfs
3. See Sections

Section II at

4a. $H_2 =$ 9.7' $A_2 =$ 3100 SF $L_2 =$ 1400' $V_2 =$ 390 Acft *

b. $Q_{p2} = Q_{p1}(1-V_2/S) =$ 10400 cfs

c. $H_2 =$ 6.7 $A_2 =$ 1900 SF

$A_A =$ 2600 SF $V_2 =$ 290 Acft **

$Q_{p2} = 20200(1-290/825) = 11100$ cfs $H = 7.3'$

Section III at

4a. $H_3 =$ 7.3 $A_3 =$ 2500 SF $L_3 =$ 600' $V_3 =$ 34.4 Acft

b. $Q_{p3} = Q_{p2}(1-V_3/S) =$ 12550 cfs

c. $H_3 =$ 7.1' $A_3 =$ 2300 SF

$A_A =$ 2450 SF $V_3 =$ 33.7 Acft

$Q_{p3} = 11100(1-33.7/825) = 10650$ cfs $H = 6.9'$

Section IV at

4a. $H_4 =$ 6.9 $A_4 =$ 2100 SF $L_4 =$ 700' $V_4 =$ 33.9 Acft

b. $Q_{p4} = Q_{p3}(1-V_4/S) =$ 10250 cfs

c. $H_4 =$ 6.85' $A_4 =$ 2050 SF

$A_A =$ 2260 SF $V_4 =$ 36.4 Acft

$Q_{p4} = 10685(1-34.4/825) = 10215$ cfs $H = 6.9'$

* Includes pond storage of 290 Acft

** Includes pond storage of 210 Acft

Section V at

4a. H_5 = 25' A_5 = 15000 L_5 = 700 (at culvert) V_5 = 596 Acft *

b. $Q_{P5} = Q_{P4}(1-V_5/S)$ = 2835 cfs

c. H_5 = 12.5 A_5 = 4032

A_A = 5900 V_5 = 1415 Acft *

Q_{P5} = $10215(1-145/825) = 8420$ cfs H = 23.7'

Section VI at

4a. H_6 = _____ A_6 = _____ L_6 = _____ V_6 = _____ Acft

b. $Q_{P6} = Q_{P5}(1-V_6/S)$ = _____ cfs

c. H_6 = _____ A_6 = _____

A_A = _____ V_6 = _____ Acft

Section VII at

4a. H_7 = _____ A_7 = _____ L_7 = _____ V_7 = _____ Acft

b. $Q_{P7} = Q_{P6}(1-V_7/S)$ = _____ cfs

c. H_7 = _____ A_7 = _____

A_A = _____ V_7 = _____ Acft

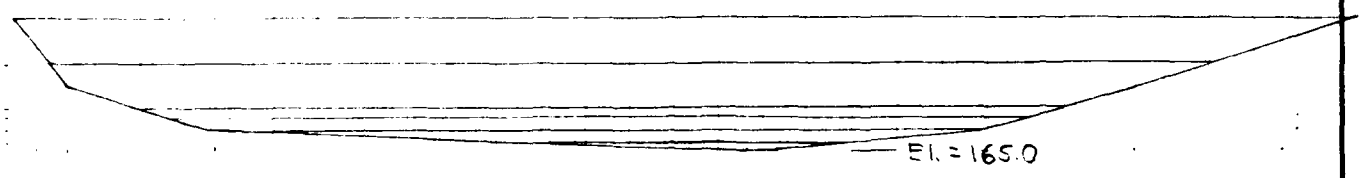
Q_{P7} =

* Includes dead storage of 355 Acft
** Includes dead storage of 50 Acft

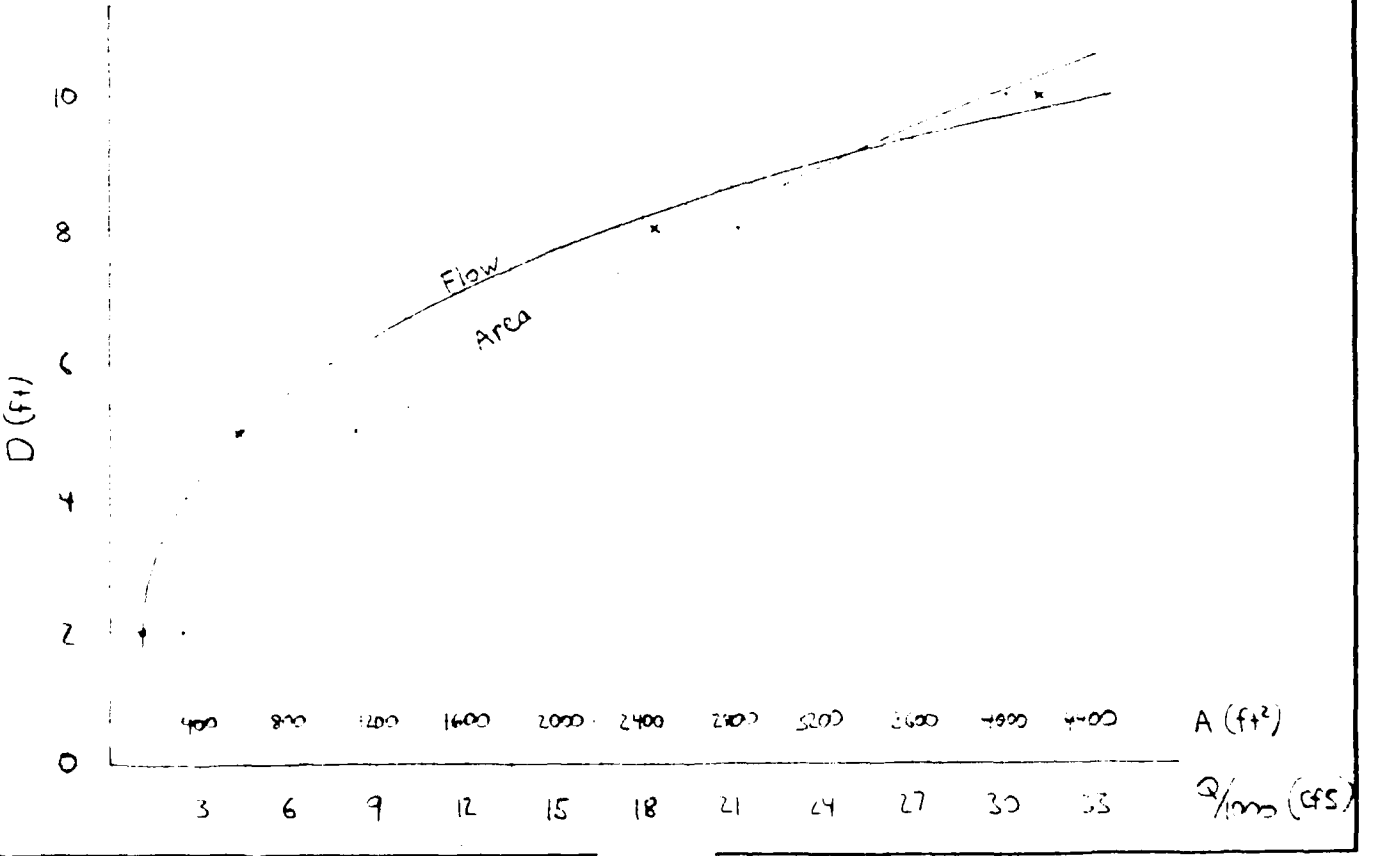
STORCH ENGINEERS/STORCH ASSOCIATES
Engineers - Landscape Architects
Planners - Environmental Consultants

JOB
SHEET NO I, II, III & IV OF
CALCULATED BY DATE
CHECKED BY DATE 5/27/80
SCALE

S = 0.56%
n = 0.05



D	WP	A	R	$R^{2/3}$	$S^{1/2}$	V	Q
2	201	336	1.672	1.409	0.075	3.130	1,052
5	483	1,104	2.286	1.735	"	3.854	4,255
8	576	2832	4.917	2.891		6 421	18,184
10	618	4,032	6.524	3.492		7.756	31,272
20	780	11,232	14.400	5.919		13.147	147,667
30	902	20,064	22.219	7.904		17.556	352,345



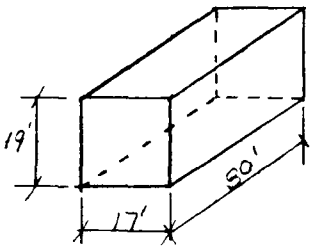
FORM 204 * Available from [illegible] Mass. [illegible]

STORCH ENGINEERS/STORCH ASSOCIATES
Engineers - Landscape Architects
Planners - Environmental Consultants

JOB
SHEET NO Section II OF
CALCULATED BY GJG DATE 10/29/80
CHECKED BY EJC DATE 12/15/80
SCALE

HEAD CALCULATIONS FOR CONCRETE CULVERT

$$H = \left[\frac{1555(1+Ke)}{D^{4}} + \frac{287.64\,n^2 L}{D^{16/3}}\right]\left(\frac{Q}{10}\right)^2$$



$n = .012$
$K = .25$

$y_c = .315\sqrt[3]{Q^2/g}$

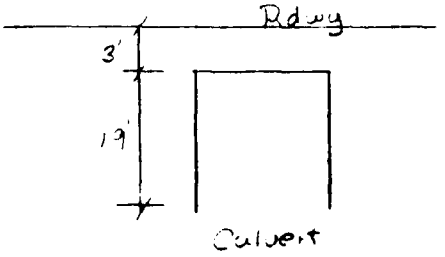
$TW = (19 + y_c)/2$ $\qquad$ $HW = H + TW$

Q	H	TW	HW
250	.019	9.8	9.82
500	.05	10.0	10.05
1000	.19	10.2	10.4
2500	1.2	10.9	12.97
5000	4.7	11.7	16.4
7000	10.6	12.3	22.9
10000	18.8	13.0	31.8

WEIR FLOW CALCULATIONS

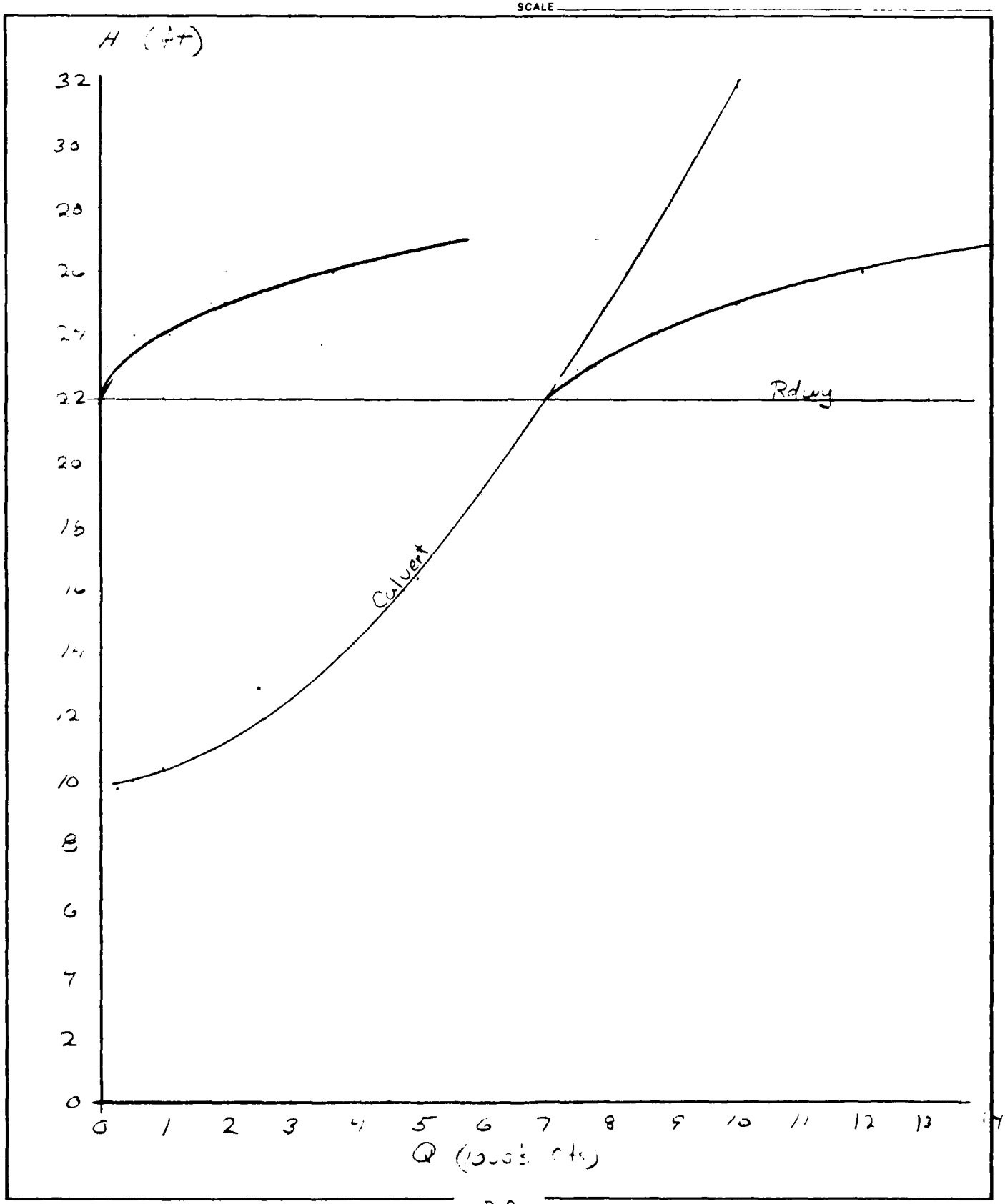
$Q = CLH^{1.5}$ $\qquad$ $C = 2.55$

H	L	Q
1	120	306
2	130	940
3	150	1990
4	180	3675
5	200	5700



STORCH ENGINEERS/STORCH ASSOCIATES
Engineers - Landscape Architects
Planners - Environmental Consultants

JOB
SHEET NO Section V OF
CALCULATED BY GJG DATE 10/26/83
CHECKED BY BJC DATE 2/5/84
SCALE



APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

Plate 4

END

FILMED

8-84

DTIC